AF/2800

Docket No.: 3905

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
IN THE MATTER OF THE APPLICATION FOR PATENT

OF: Takao NAKAMURA et al. | ART UNIT: 2814
SERIAL NO.: 09/519,408 | EX.: W. S. Louie
FILED: March 3, 2000 |

FOR: Semiconductor Light-Emitting Device, Method of Manufacturing Transparent Conductor Film and Method of Manufacturing Compound Semiconductor Light-Emitting Device

MS AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

September 8, 2003

COVER LETTER FOR APPELLANT'S BRIEF

Dear Sir:

1) The Notice of Appeal was mailed on May 5, 2003, and was received in the USPTO on May 8, 2003.

2) Appellant's Appeal Brief, including Appendix A, is enclosed in triplicate. A two month Term Extension Request is also enclosed.

3) Our Credit Card Payment Form (PTO-2038) in the amount of $730.00 is enclosed to cover the official Appeal Brief fee and the Term Extension fee. Any fee deficiency or additional fee properly due may be charged to Deposit Account 50-0507.

Takao NAKAMURA et al.
Applicant/Appellant

By _____
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WFF:ar/3905
Enclosures: postcard,
Term Extension Request,
Form PTO-2038,
3 copies of Brief with
Appendix

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I hereby certify that this correspondence with all indicated enclosures is being deposited with the U. S. Postal Service with sufficient postage as first-class mail, in an envelope addressed to: COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450 on the date indicated below.

_____ 9/8/03
Name: Walter F. Fasse - Date: September 8, 2003

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BRIEF ON BEHALF OF APPLICANT/APPELLANT

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Walter F. Fasse 9/8/03

Name: Walter F. Fasse - Date: September 8, 2003

3905/WFF:ar

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TABLE OF LEGAL AUTHORITIES

TABLE OF REFERENCES RELIED ON BY EXAMINER

US Patent 5,617,446 (Ishibashi et al.)
JP 06-318406 (Kazuyoshi et al.)
US Patent 6,255,003 (Woodard et al.)
US Patent 4,495,514 (Lawrence et al.)
US Patent 5,990,500 (Okazaki)
US Patent 6,271,460 (Yamashita et al.)

I. REAL PARTY IN INTEREST

The real party in interest in this Appeal is:

Sumitomo Electric Industries, Ltd.
5-33, Kitahama 4-chome
Chuo-ku, Osaka-shi
Osaka, Japan

to which the entire right, title and interest in the present application have been assigned by an Assignment executed on February 22, 2000 and recorded in the U. S. Patent and Trademark Office on March 3, 2000 at Reel 010605, Frame 0669.

II. RELATED APPEALS AND INTERFERENCES

No related appeals or interferences are known.

III. STATUS OF CLAIMS ON APPEAL

Claims 1 to 15, 17 and 18 have been cancelled.

Claims 16 and 19 to 29 are pending and were finally rejected in the Final Office Action of February 3, 2003. Among the pending claims, claims 16 and 19 to 22 were amended, and claims 23 to 29 were newly presented, in the Response of November 12, 2002.

This Appeal relates to all of the finally rejected claims 16 and 19 to 29 as set forth in the Response of November 12, 2002.

IV. STATUS OF AMENDMENTS AND OTHER PAPERS FILED AFTER FINAL REJECTION

No further amendment has been filed after the Final Office Action of February 3, 2003.

On May 5, 2003, Appellant filed an Information Disclosure Statement, of which Appellant has not yet received an acknowledgment.

On May 5, 2003, Appellant timely filed a Notice of Appeal by mail, with a Certificate of Mailing. The Notice of Appeal was received in the USPTO on May 8, 2003. The Notice of Appeal applied to all pending finally rejected claims 16 and 19 to 29.

A further Information Disclosure Statement is being filed together with this Appeal Brief.

V. SUMMARY OF THE INVENTION

A) THE INVENTION OF INDEPENDENT CLAIM 16

The present invention is generally directed to a semiconductor light-emitting device having a layered structure, for example as shown in present Fig. 2. The layered structure includes a substrate (1), an n-type lower electrode (12) on a back or bottom surface of the substrate (1), a light-emitting layer (e.g. 4) arranged on top of the substrate, a p-type semiconductor layer (e.g. 8) arranged on top of the light-emitting layer, and an upper electrode (10a, 10b) arranged on top of the p-type semiconductor layer. The specific example embodiment shown in Fig. 2 includes additional layers that are not important for the present discussion of the patentably significant features of the invention. In this regard, generally see page 4, lines 22 to 29 and page 9, lines 12 to 24 of the specification.

The purpose of the upper electrode (10a, 10b) in the above discussed general layered structure of the light-emitting device is to inject and spread an input current into the underlying p-type semiconductor layer and from there to the light-emitting layer to cause the emission of light due to the recombination of the injected electrons and holes. Secondly, the upper electrode (10a, 10b) must allow the light generated within the light-emitting layer to be transmitted through the upper electrode so as to be emitted outwardly from the top of the light-emitting device. Thus, the three important considerations for the upper electrode (10a, 10b) are that it must provide a good electrical conductivity for spreading the injected current across the upper surface of the device, a good electrical contact with the underlying p-type semiconductor layer (8) for injecting the current efficiently into the semiconductor material, and a good optical transmissivity for allowing the internally generated light to be emitted out of the device.

It is known in the prior art to provide a thin film of gold (Au) on the surface of a light-emitting device to act as a current injection layer or current diffusion electrode. In order to achieve an adequate electrical conductivity, and thus an adequate current injection and current spreading effect, the Au film by itself must have a thickness of about 20 nm (see the present specification at page 3, lines 3 to 10, as well as present comparative Fig. 1B and its description at page 9, lines 1 to 3). With such a thickness, however, the Au film is only poorly transmissive to light, e.g. only about 37% light transmissive at a wavelength of 500 nm (specification page 3, lines 11 to 13). Thus, while such a conventionally utilized Au film with a thickness of about 20 nm achieves good current spreading and current injection into the underlying semiconductor material of the light-emitting device, this (rather thick) Au film absorbs and thus blocks much of the internally generated light, resulting in an inferior overall luminous output efficiency of the device. It is not possible to make the Au film by itself thinner so as to improve its light transmissivity, because then the electrical conductivity of the film is deteriorated to the point that it can no longer adequately spread the injected current.

As an alternative arrangement, it is also known in the prior art to provide a doped semiconductor layer at or near the surface of a light-emitting device, as a current spreading layer (see present comparative Fig. 1C, and the specification at page 8, line 32 to page 9, line 1). While such a doped semiconductor layer can be made sufficiently thick to provide good electrical conductivity and thus good current spreading while maintaining high optical transmissivity, it cannot achieve a good electrical contact with the underlying semiconductor material. Namely, there is essentially no available p-type transparent semiconductor material that would be suitable in this regard for use on the p-side of the device. On the other hand, while there are n-type transparent semiconductor materials available for use as a conductor layer, forming such an n-type semiconductor layer directly on the underlying p-type semiconductor material would form a pn-junction with a resulting barrier potential for current injection across this junction. That would undesirably increase the driving or input voltage necessary for activating the active layer. Thus, on the p-side of the device, it is generally necessary to use either a metal or a p-type semiconductor material to form the electrode and current spreading layer, to avoid the formation of a pn-junction. In this regard, see the present specification at page 5, lines 7 to 9; and page 8, line 32 to page 9, line 3.

The present invention aims to avoid the above discussed disadvantages and problems associated with the use of a relatively thick Au film, and the above discussed disadvantages and problems associated with the use of an n-type transparent semiconductor film directly in contact with a p-type semiconductor material. Namely, the invention avoids the low optical transmissivity of a relatively thick Au film, and avoids the formation of a pn-junction directly between an n-type transparent semiconductor film of the upper electrode and the underlying p-type semiconductor layer of the light-emitting device. To achieve this, the invention provides a multi-layered structure of the upper electrode (10) including both an Au thin film (10a) positioned in contact with the p-type semiconductor layer (8) of the underlying semiconductor material of the device, as well as an n-type transparent semiconductor film (10b) formed on the Au thin film (10a). More particularly, the Au thin film has a thickness of 1 nm to 3 nm,

and the n-type transparent semiconductor film of the upper electrode is made of In_2O_3-10 wt. % ZnO (IDIXO). See the specification at page 4, line 22 to page 5, line 24; page 9, lines 4 to 24.

If the Au thin film with a thickness of 1 to 3 nm were used by itself as a current spreading layer, this layer would not be sufficiently conductive to spread the current over the entire area of the underlying p-type semiconductor layer. In order to make up for the insufficient current-spreading ability of the Au thin film (10a) by itself, the inventive upper electrode (10) further includes a second layer of a transparent n-type semiconductor material, particularly IDIXO. This combination of the Au film and the IDIXO layer together provides sufficient electrical conductivity for spreading the current to be injected over the entire area of the underlying p-type semiconductor layer of the device. Simultaneously, the provision of the Au thin film between the n-type IDIXO semiconductor layer of the upper electrode and the underlying p-type semiconductor layer of the device serves to reduce or avoid the formation of a pn-junction between these two heterogeneous semiconductor materials. Thus, it can be said that the present invention provides the n-type transparent semiconductor film in the upper electrode to supplement the inadequate electrical conductivity of the Au thin film. Alternatively, it can be said that the present invention provides the Au thin film in the transparent upper electrode, between the n-type transparent semiconductor film of the upper electrode and the p-type semiconductor layer of the device, in order to reduce or avoid the formation of a pn-junction between the heterogeneous semiconductor materials.

The invention has made it possible to provide a transparent n-type semiconductor layer in a transparent upper electrode on the p-side of a light-emitting device, namely on the underlying p-type semiconductor material of the light-emitting device. This is achieved by providing a very thin Au film between the transparent n-type semiconductor layer of the upper electrode and the underlying p-type semiconductor material of the light-emitting device, to achieve the "best of both worlds" while avoiding the above discussed disadvantages. Namely, by

providing the Au film with a thickness of 1 to 3 nm, this film is **thick enough** to avoid or reduce the formation of a pn-junction between the p-type semiconductor material of the light-emitting device and the n-type transparent semiconductor layer of the upper electrode. Simultaneously, this Au film with a thickness of 1 to 3 nm is **thin enough** to avoid a significant reduction of the light transmittance through the upper electrode. The combination of these two layers in the upper electrode thus achieves a high electrical conductivity and current spreading, a good contact and current injection into the underlying semiconductor material of the device, and a good light transmittance to efficiently allow the internally generated light to be emitting out of the device through the upper electrode. The inventive multi-layered upper electrode thus provides enhanced synergistic effects in comparison to either one of the individual component layers (either the Au film or the n-type transparent semiconductor film) considered by itself.

B) THE INVENTIVE FEATURES OF DEPENDENT CLAIMS 19 TO 29

The inventive features of claims 19, 20, 22, 23 and 28 do not need to be discussed separately, because these claims stand or fall together with independent claim 16 for purposes of this Appeal, as explained below.

Claim 21 recites that the n-type transparent semiconductor film of the upper electrode **itself** has a multi-layer structure including an upper semiconductor layer and a lower semiconductor layer, whereby the lower layer has a flattened surface and the upper layer has an uneven surface. In this regard, see the specification at page 5, lines 25 to 34 and page 12, lines 1 to 9. It is important to note that this claim is referring to a multi-layer structure of the n-type transparent semiconductor film itself, in addition to the Au thin film that forms another layer of the upper electrode. As demonstrated in the present specification, such a multi-layer structure of the n-type transparent semiconductor film of the upper electrode, whereby the lower layer has a flattened surface and the upper layer has an uneven surface, serves to

increase the optical emission efficiency, so as to increase the total optical output of the device (see e.g. page 12, lines 1 to 9 of the specification).

Claims 24 and 25 recite a further feature of the invention, whereby the Au thin film of the upper electrode is discontinuous so that it covers first areas of the p-type semiconductor layer while leaving second areas of the p-type semiconductor layer uncovered. Then, the n-type transparent semiconductor film covers both the Au film as well as the second areas of the p-type conductor layer that are not covered by the Au film. Claim 25 further makes clear that the Au thin film comprises separate discontinuous islands of the Au thin film on the first areas of the p-type semiconductor layer. In this regard, see page 17, lines 10 to 15 of the present specification. Such a thin discontinuous film of Au avoids an impairment of the optical transmissivity of the upper electrode, and while it allows some contact between the n-type transparent semiconductor film of the upper electrode and the underlying p-type semiconductor layer, it nonetheless achieves good electrical current injection and spreading and good resultant optical output, due to the high electrical conductivity of the Au film. See page 11, lines 1 to 19 and page 17, lines 1 to 22 of the specification.

Claim 26 is directed to a particular oxygen content of the n-type transparent semiconductor film of the upper electrode. Namely, claim 26 recites that the n-type transparent semiconductor film contains a particular oxygen content that minimizes the oxygen-content-dependent variable electrical resistance of the n-type transparent semiconductor film for a given thickness thereof. In this regard see page 15, line 25 to page 16, line 26. With such a feature of a precise oxygen content that minimizes the variable electrical resistivity of the n-type transparent semiconductor film, the invention is able to form the upper electrode with a minimized electrical resistance and thereby a maximized current spreading and injection effect, for a given thickness of the n-type transparent semiconductor film. Further dependent claim 27 makes clear that the oxygen content of the n-type transparent semiconductor film can

be optimized by adjusting the partial pressure of oxygen while forming the film by a laser ablation process.

Claim 29 recites that the Au thin film interposed between the n-type transparent semiconductor film of the upper electrode and the underlying p-type semiconductor layer has a thickness sufficient so that the Au thin film prevents the formation of a pn-junction between these two heterogeneous semiconductor layers. In this regard see the specification at page 5, lines 3 to 20 and page 8, line 32 to page 9, line 11. By avoiding the formation of a pn-junction, the Au thin film avoids or reduces the potential barrier that would otherwise exist at such a pn-junction, and thus reduces the operating voltage needed to drive the device (see page 11, lines 1 to 12 of the present specification).

VI. ISSUES PRESENTED FOR REVIEW

A) FIRST ISSUE: Is claim 24 supported by an adequate written description?

B) SECOND ISSUE: Is claim 24 supported by the original disclosure to avoid new matter?

C) THIRD ISSUE: Are claims 24 and 28 clear and definite so as to particularly point out and distinctly claim the subject matter regarded as the invention?

D) FOURTH ISSUE: Are claims 16, 19, 20, 22 and 23 unobvious and thus patentable over Ishibashi et al. in view of Kazuyoshi et al. and Woodard et al.?

E) FIFTH ISSUE: Is claim 21 unobvious and thus patentable over Ishibashi et al. in view of Kazuyoshi et al. and Woodard et al. and further in view of Lawrence et al.?

F) SIXTH ISSUE: Are claims 24 to 28 unobvious and thus patentable over Ishibashi et al. in view of Kazuyoshi et al. and Woodard et al. and further in view of Okazaki?

G) SEVENTH ISSUE: Is claim 29 unobvious and thus patentable over Ishibashi et al. in view of Kazuyoshi et al. and Woodard et al. and further in view of Yamashita et al.?

VII. GROUPING OF CLAIMS

For the purposes of this Appeal, the claims will be considered to stand or fall together as follows. With regard to the indefiniteness rejection, claims 24 and 28 will each be treated individually and do not stand or fall together. With regard to the obviousness rejection of claims 16, 19, 20, 22 and 23, the dependent claims 19, 20, 22 and 23 will not be argued separately, but rather will stand or fall together with the independent claim 16. Regarding the obviousness rejection of claims 24 to 28, claims 24 and 25 will stand or fall together as one group on the basis of claim 24, claims 26 and 27 will stand or fall together as another group on the basis of claim 26, and claim 28 will stand or fall together with the independent claim 16 without being separately argued.

VIII. ARGUMENT

A) FIRST ISSUE - ADEQUATE WRITTEN DESCRIPTION OF CLAIM 24

1) Legal Standards for Adequate Written Description

35 U.S.C. §112 first paragraph requires that:

"The specification shall contain a written description of the invention ...".

This statutory provision has been interpreted by the courts as setting forth a "Written Description" requirement, separate and distinct from an "Enablement" requirement and a "Best Mode" requirement. To satisfy the Written Description requirement, the original disclosure must convey with reasonable clarity to a person of ordinary skill in the art that the invention ultimately being claimed had actually been invented by the inventors at the time the original application was filed, i.e. that the inventors, at the time the application was filed, had possession of the ultimately claimed invention. *Vas-Cath Inc. v. Mahurkar*, 19 USPQ2d 1111, 1116-17 (Fed. Cir. 1991); M.P.E.P. §2161, 2163.

The Written Description requirement may be satisfied by the disclosure of an actual embodiment or reduction to practice of the claimed invention, which demonstrates that the inventors had actual possession of this physical embodiment including all of the claimed features of the ultimately claimed invention. M.P.E.P. §2163 II.A.3.(a); 2193.02.

The Written Description requirement does not require the exact words of the claim at issue to be included in the original description, as long as the claimed inventive features are expressly, implicitly, or inherently included in the subject matter that is originally described. Inherent features are also regarded as a part of the original adequate description. M.P.E.P. §2163; 2163.02; *Vas-Cath Inc.*, 19 USPQ2d at 1116; *In re Wright*, 9 USPQ2d 1649, 1650-51 (Fed. Cir. 1989); *Kennecott Corp. v. Kyocera International Inc.*, 5 USPQ2d 1194 (Fed. Cir. 1987); *Wang Laboratories Inc. v. Toshiba Corp.*, 26 USPQ2d 1767, 1774 (Fed. Cir. 1993).

Information that is well known in the art or readily understood by persons of ordinary skill in the art need not be described in detail in the specification. M.P.E.P. §2163; *Wang Laboratories Inc.*, 26 USPQ2d at 1774; *Ralston Purina Company v. Far-Mor-Co., Inc.*, 227 USPQ 177, 179-80 (Fed. Cir. 1985).

2) Examiner's Errors Regarding Adequate Written Description

In the Final Office Action, claim 24 was rejected under 35 U.S.C. §112, first paragraph as containing subject matter that was not supported by an adequate written description in the original specification so as to reasonably convey to one of ordinary skill in the art that the inventors had possession of the claimed invention at the time the application was filed.

Claim 24 recites that "said Au thin film is discontinuous so as to cover first areas of said p-type semiconductor layer while leaving second areas of said p-type semiconductor layer uncovered...". The Examiner asserted that this feature of claim 24 is not disclosed in the original specification, so it represents new matter. This is erroneous, because this feature is adequately disclosed in the original written description at page 17, lines 10 to 15, in a manner so as to reasonably convey to a person of ordinary skill that the inventors had possession of the claimed invention at the time the application was filed.

3) Discussion of the Application's Original Written Description

At page 17, lines 10 to 15, the original written description explains that when the thickness of the Au film was 3 nm in particular test examples, the Au film was "grown in the form of an island", which can be readily understood by persons of ordinary skill in the art as referring to a discontinuous Au thin film that only covers certain areas of the underlying p-type semiconductor layer while leaving other areas of the underlying p-type semiconductor layer uncovered by the Au material. This is an original disclosure and written description of a physical embodiment of the invention that was actually reduced to practice and in the possession of the inventors, whereby this actual physical embodiment expressly, implicitly and inherently included all of the features of present claim 24.

The original written description at page 17, lines 13 to 15 goes on to explain that when the thickness of the Au film was increased to 10 nm, then the Au material formed a continuous film. This further supports the original disclosure that the thinner Au film with a thickness of only 3 nm was discontinuous so as to form individual islands of Au material on some areas of the underlying p-type semiconductor layer, while leaving other areas of the underlying semiconductor material uncovered by the Au material.

In this regard, to further clarify the level of ordinary knowledge and understanding of persons skilled in this field, see the Examiner's cited U. S. Patent 5,990,500 (Okazaki) at col. 7, lines 17 to 28 in connection with Fig. 4 of the reference. That prior art disclosure demonstrates that persons of ordinary skill in the art understand what it means when a metal film is deposited to be very thin, i.e. with a very small thickness, so that the film is discontinuous in the form of individual islands, thereby covering only certain areas of the underlying material while leaving other areas uncovered.

4) Conclusion of Adequacy of Written Description

In view of the above, the original written description at page 17, lines 10 to 15 of the specification would have reasonably conveyed to a person of ordinary skill in the art that the present inventors had possession of the inventive subject matter of claim 24 at the time this application was filed. It is not necessary for the original written description to use exactly the same **words** of claim 24, but rather merely to describe the same **subject matter** covered by claim 24, with sufficient clarity and precision to reasonably indicate to an ordinarily skilled artisan that this feature of the invention had been invented and possessed by the inventors at the time the application was filed. These requirements are satisfied by page 17, lines 10 to 15 of the specification, in compliance with 35 U.S.C. §112, first paragraph. The disclosed actual physical embodiment of the invention in the possession of the inventors had the features recited in claim 24. Since persons of ordinary skill are generally knowledgeable about the possibility

of forming a discontinuous thin film in the manner of individual islands, these features did not need to be described in great detail in the original specification.

B) SECOND ISSUE - LACK OF NEW MATTER IN CLAIM 24

1) Legal Standards Regarding New Matter

35 U.S.C. §132(a), inter alia, sets forth "No amendment shall introduce new matter into the disclosure of the invention".

In the present case, the issues relating to the alleged new matter are subject to Appeal (rather than Petition), because the new matter issues are involved in the rejection of claim 24. M.P.E.P. §608.04(c) and §2163.06(II). Formally, a claim that introduces new matter is subject to rejection under 35 U.S.C. §112, first paragraph.

See the above discussion regarding the legal principles underlying the Written Description requirement, which corresponds to the New Matter requirement in the present context.

2) Examiner's Errors Regarding New Matter

The new matter issue arises in the context of the rejection of claim 24 under 35 U.S.C. §112, first paragraph. As discussed in the preceding section of the argument, the Examiner asserted that the original disclosure does not support the feature of claim 24 whereby "said Au thin film is discontinuous so as to cover first areas of said p-type semiconductor layer while leaving second areas of said p-type semiconductor layer uncovered". The Examiner's assertion that this feature of claim 24 represents new matter, is erroneous, because this feature is supported in the original specification.

3) Discussion of Original Disclosure

As discussed above, the original specification at page 17, lines 10 to 15 describes an embodiment of the invention in which the Au film is so thin that it is "grown in the form of an island", and when the Au film is made thicker, then it forms a continuous film. This original disclosure demonstrates that the subject matter of claim 24, while not necessarily the exact terminology of claim 24, was originally disclosed and supported in the specification.

4) Conclusion of No New Matter

In view of the above, the subject matter of claim 24 is not new matter, because it is originally supported in the specification at page 17, lines 10 to 15. Merely using different terminology to claim that originally disclosed subject matter does not introduce new matter. Namely, there does not need to be exact correspondence between the claim terminology and the specification terminology, as long as the subject matter being claimed was included in the original disclosure. Even inherent features of the originally disclosed invention count as a part of the original disclosure. So, even though it was not originally expressly disclosed that the discontinuous film of Au grown in the form of islands will cover some areas of the underlying semiconductor layer while leaving other areas of the underlying semiconductor layer uncovered by the Au material, this is clearly an inherent feature of the originally disclosed discontinuous island-form Au thin film. Thus, claim 24 does not introduce any new matter.

C) THIRD ISSUE - DEFINITENESS OF CLAIMS 24 AND 28

1) Legal Standards for Definiteness

The second paragraph of 35 U.S.C. §112 sets forth "The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the

applicant regards as his invention". This has been interpreted as including two separate requirements: (A) that the claims must define the subject matter that the applicants regard as their invention; and (B) that the claims must particularly point out and distinctly define, in a clear and definite manner, the scope and bounds of the subject matter to be protected by the respective claim. M.P.E.P. §2171.

Regarding the first requirement, in the absence of any evidence to the contrary, the invention set forth in the claims must be presumed to be the inventive subject matter regarded by the applicants as their invention. See M.P.E.P. §2172.

Regarding the second requirement, the terminology of the claims must define the patentable subject matter with a reasonable degree of particularity and distinctness. The focus of the analysis for this requirement is whether the claim language meets a minimum threshold of clarity and precision, and not whether more suitable language or a better mode of expression may be available or favored by the Examiner. A range of latitude in the claim language must be permitted. M.P.E.P. §2173, §2173.02.

The claim language must be analyzed for clarity and definiteness on its face (i.e. in view of the actual claim language itself), and if that language is deemed indefinite or unclear, it should be further interpreted in view of the understandings of the relevant terms by persons of ordinary skill in the art, the content of the application, and the teachings of the prior art. M.P.E.P. §2173.02. The terminology of the claim may not be directly inconsistent with the terminology of the specification disclosure, but it is not required that the claim terminology must exactly match the terms of the written description. *Wright*, 9 USPQ2d at 1651. The focus of the inquiry must always be whether the terms and phrases used in the claim define the invention with a reasonable degree of clarity and precision. M.P.E.P. §2173.05(e). The law requires only that the claims reasonably apprise persons of ordinary skill of the claim scope. *Miles Laboratories Inc. v. Shandon Inc.*, 27 USPQ2d 1123, 1125-26 (Fed. Cir. 1993); *Credle*

v. Bond, 30 USPQ2d 1911, 1919-20 (Fed. Cir. 1994); *Orthokinetics Inc. v. Safety Travel Chairs Inc.*, 1 USPQ2d 1081, 1087-88 (Fed. Cir. 1986).

In general, the applicant can rely on the ordinarily understood meaning of words used in the claims, as well as the understanding of such words by persons of ordinary skill in the art. When a claim is composed of common words that are generally known in ordinary English, it is not appropriate to reject the claim as indefinite regarding the clarity of the meaning of such commonly understood terms. *Wright*, 9 USPQ2d at 1651.

It is not the purpose of the claims to explain the technology or how it works, but rather to define the legal boundaries of the subject matter protected by the patent grant. A claim is not indefinite merely because it is difficult to understand when viewed without an understanding of the invention as disclosed in the specification. *S3 Inc. v. nVIDIA Corp.*, 59 USPQ2d 1745, 1748-49 (Fed. Cir. 2001).

2) Examiner's Errors Regarding Definiteness

In the Final Office Action, claim 24 (and apparently also claim 28) was/were rejected under 35 U.S.C. §112, second paragraph as being indefinite.

In claim 24, the Examiner misquoted the claim as setting forth "*said Au thin film is discontinuous so as to cover said p-type semiconductor*". That misquotation of claim 24 omits important features that clarify the intended meaning of claim 24, as will be discussed below. The Examiner further misquotes claim 24 as reciting "*said n-type transparent semiconductor film covers Au thin film*". The true recitation of claim 24 needs to be considered in its overall context as will be discussed below.

Further regarding claim 24, the Examiner asked *"How can an n-type electrode cover a p-type Au thin electrode?"*. This question demonstrates a misunderstanding of claim 24, and of the technical subject matter underlying the invention, as will be discussed below.

Regarding claim 28, the Examiner asks "*is the upper electrode includes an Au thin film and an n-type transparent semiconductor film? The upper electrode 10, in according to fig. 2, is a p-type electrode*". This question and statement by the Examiner demonstrate a misunderstanding of claim 28, of the invention, of the technical subject matter underlying the invention, and of the proper examination of claims rather than drawing figures, as will be discussed below.

3) Discussion of the Claim Language

Claim 24 recites that the Au thin film of the upper electrode is discontinuous so as to cover first areas of the underlying p-type semiconductor layer while leaving second areas of the underlying p-type semiconductor layer uncovered. Claim 24 further recites that the n-type transparent semiconductor film of the upper electrode covers both the Au film as well as the second areas of the p-type semiconductor layer that are not covered by the Au film.

The meaning and scope of this terminology of claim 24 is clearly understandable in connection with the ordinary meanings of the words used in the claim. In the rejection of claim 24, the Examiner has not set forth exactly what is regarded as being unclear or indefinite. Instead, the Examiner seems concerned that the technical subject matter which is clearly defined by claim 24 is not understandable to the Examiner. Namely, the Examiner asks "*How can an n-type electrode cover a p-type Au thin electrode?*" This question introduces terms and limitations that are not recited in the present claims, and that make no sense in the context of the present invention. As a result of the Examiner's misunderstanding, the Examiner indicates "*For the purpose of examination, 'an transparent semiconductor film covers the Au thin film'*

is assumed". This improperly changes the technical subject matter that has been clearly recited in claim 24 in combination with its parent independent claim 16, and may have contributed to an improper substantive examination of this claim in comparison to the prior art (as will be discussed below).

Regardless whether the Examiner understands or believes the technical subject matter clearly defined in claim 24, that inventive subject matter involves an upper electrode that includes an Au thin film positioned in contact with an underlying p-type semiconductor layer of the device, as well as an n-type transparent semiconductor film formed on the Au thin film. So, in the inventive arrangement, an n-type transparent semiconductor film covers an Au thin film. This multi-layered upper electrode including the n-type transparent semiconductor film and the Au thin film is arranged on the p-type semiconductor layer of the device. Further according to claim 24, the Au thin film is discontinuous so that it covers only certain first areas of the underlying p-type semiconductor layer while leaving other second areas of the p-type semiconductor layer uncovered. For example, the discontinuous Au thin film comprises separate discontinuous islands of Au material dispersed on the first areas of the p-type semiconductor layer without being provided at the second areas of the p-type semiconductor layer. Further, the n-type transparent semiconductor film covers both the discontinuous portions (or islands) of the Au film at the first areas as well as the p-type semiconductor layer itself at the second areas which were not covered by the discontinuous portions of the Au film. This would all be readily and clearly understood by a person of ordinary skill by reading the claim language itself, and especially also further in connection with an understanding of the specification.

The Examiner's reference to "*an n-type electrode*" and "*a p-type Au thin electrode*" cannot be understood. It is assumed that the "*n-type electrode*" is referring to the "n-type transparent semiconductor film" and that the "*p-type Au thin electrode*" is referring to the "Au thin film". However, the Au thin film is a metal thin film and is not a p-type semiconductor material.

Furthermore, when the Au thin film is discontinuous according to claim 24, then the p-type semiconductor layer of the upper electrode will cover and contact both the discontinuous island portions of the Au thin film as well as the areas of the underlying p-type semiconductor layer that are not covered by the discontinuous Au islands. The Examiner's question might be indicating a concern about the pn-junction that may be formed when an n-type transparent semiconductor film of the upper electrode directly contacts the underlying p-type semiconductor layer of the device. It is exactly such a concern that is addressed by the present invention, namely by providing an Au thin film in contact with at least discontinuous areas of the underlying p-type semiconductor layer, before covering the Au thin film and the underlying p-type semiconductor layer with the n-type transparent semiconductor film of the upper electrode, so as to reduce or avoid the formation of a pn-junction.

In any event, the terminology of claim 24 clearly, particularly, and distinctly defines the subject matter regarded as the invention by the applicants, in a manner that would be reasonably understandable to a person of ordinary skill in the art. To the extent that the Examiner questions the functionality or operability of the claimed subject matter, that is not a proper basis for an indefiniteness rejection.

Claim 28, which was apparently also rejected as indefinite under 35 U.S.C. §112, second paragraph, recites that the Au thin film and the n-type transparent semiconductor film are respective solid continuous films, and that the upper electrode does not include a grid-shaped electrode. This terminology of the claim is readily understandable based on the ordinary meanings of these ordinary words. Regarding this claim, the Examiner has not identified any particular terminology that is considered to be unclear or indefinite. Instead, the Examiner has merely asked "*is the upper electrode includes an Au thin film and an n-type transparent semiconductor film?*" The answer to that question (to the extent it can be understood) is yes, the upper electrode includes an Au thin film and an n-type transparent semiconductor film, as

clearly defined in the parent independent claim 16, which does not become unclear or questionable in further dependent claim 28.

Regarding claim 28, the Examiner further points outs "*The upper electrode 10, in according to fig. 2, is a p-type electrode*". It should be pointed out that the Examiner must examine the claims and not the drawing figures which merely represent particular example embodiments. Furthermore, the clarity of the claim terminology is not implicated by any disclosure of the drawing figures. Nonetheless, to help clarify the understanding of the inventive subject matter, the example embodiment of a light-emitting device according to Fig. 2 includes an upper electrode (10, 10a, 10b) on the upper, light-emitting p-side of the device. Namely, this upper electrode (10) is provided on the side of the device having the p-type semiconductor material. Thus, this upper electrode (10) can be called the p-side electrode. That does not mean, however, that the transparent semiconductor film (10b) of this upper electrode (10) is a p-type semiconductor material. Quite to the contrary, the transparent semiconductor film (10b) is an n-type transparent semiconductor film (10b), which is made possible according to the invention by additionally providing the Au thin film (10a) in contact with the underlying p-type semiconductor layer of the device. In prior art devices without such an Au thin film, it would have been disadvantageous to provide an n-type transparent semiconductor film in a p-side electrode directly in contact with an underlying p-type semiconductor layer of the device, as apparently being recognized or questioned by the Examiner, because of the formation of a pn-junction and the resulting potential barrier that would result. Nonetheless, the Examiner must examine the inventive subject matter as clearly defined in the claims, and the claim at issue (when properly understood) is not fatally inconsistent with the remainder of the disclosure for the reasons discussed above.

4) Conclusion of Definiteness

For the above reasons, the terminology of claims 24 and 28 is sufficiently clear and distinct to be reasonably clearly understandable to a person of ordinary skill in the art. Namely, a person of ordinary skill in the art would reasonably understand the meaning and scope of the inventive subject matter recited in claims 24 and 28, and the Examiner's questions regarding the technical merits of that inventive subject matter do not relate to the clarity and understandability of the claim terminology.

D) FOURTH ISSUE - NON-OBVIOUSNESS OF CLAIMS 16, 19, 20, 22, 23 OVER ISHIBASHI ET AL. COMBINED WITH SECONDARY REFERENCES

1) Legal Standards for Obviousness Determination

Under 35 U.S.C. §103(a), an invention is not patentable "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains". 35 U.S.C. §103(a)

The Supreme Court has interpreted 35 U.S.C. §103, and required that the obviousness determination must be made on the basis of four factual inquiries, namely: i) the scope and content of the prior art; ii) the level of ordinary skill in the pertinent art; iii) differences between the prior art and the claims at issue; and iv) secondary considerations or objective indicia of non-obviousness, such as commercial success, long felt but unsolved needs, failure of others, etc. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966).

The scope and content of the prior art and the level of ordinary skill in the art must be determined from the standpoint as of the time the invention was made, to support the

determination that the claimed invention would have been obvious at the time the invention was made on the basis of the scope and content of the prior art at that time, with care being taken that hindsight knowledge gained from the application being examined does not influence the evaluation. *Arkie Lures, Inc. v. Gene Larew Tackle, Inc.*, 43 USPQ2d 1294, 1296 (Fed. Cir. 1997). The Supreme Court and the Federal Circuit have made clear that hindsight knowledge gained from the teachings of the invention at issue cannot be used to supplement or guide the understandings of the prior art. *Graham*, 383 US at 35-36; *In re Fritch*, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992).

The scope and content of the prior art includes subject matter that is directly disclosed in the prior art, as well as subject matter that would have been fairly suggested by the prior art in such a manner that a person of ordinary skill would have had (from the prior art) a reasonable expectation of success in proceeding with such a suggestion. *In re Dow Chemical Co.*, 5 USPQ2d 1529, 1531 (Fed. Cir. 1988); *In re Vaeck*, 20 USPQ2d 1438, 1442-43 (Fed. Cir. 1991). In determining whether the prior art provides such a suggestion, the complete disclosures of the prior art must be taken into account, in the context of the entire disclosure of the reference(s) at issue, i.e. teachings of a prior art reference cannot be taken out of the overall **context** in which they were disclosed. *In re Kotzab*, 55 USPQ2d 1313, 1317-18 (Fed. Cir. 2000); *In re Evanega*, 4 USPQ2d 1249, 1251 (Fed. Cir. 1987); *In re Dow Chemical Co.*, 5 USPQ2d at 1531. One cannot "pick and choose" from a reference only those individual features appearing to support an obviousness determination, while ignoring the overall context of the reference's disclosure including those portions of the prior art that teach away from the invention. *Bausch & Lomb v. Barnes-Hind/Hydrocurve*, 230 USPQ 416, 419-20 (Fed. Cir. 1986); *Tec Air Inc. v. Denso Manufacturing Michigan, Inc.*, 52 USPQ2d 1294 (Fed. Cir. 1999); *Winner International Royalty Corp. v. Wang*, 53 USPQ2d 1580 (Fed. Cir. 2000).

Any modification or combination of the teachings of the prior art (e.g. a modification proposed by the Examiner) must be supported by a reason, suggestion or motivation **in the prior art**

(i.e. explicitly in the prior art references; or in clear, specific, pertinent prior art knowledge of persons of ordinary skill at the time of the invention; or in a prior art understanding of the problems to be solved). *In re Fritch*, 23 USPQ2d at 1783-84; *Ruiz v. A.B. Chance Co.*, 57 USPQ2d 1161 (Fed. Cir. 2000); *In re Rouffet*, 47 USPQ2d 1453, 1456-58 (Fed. Cir. 1998). Any such modification or combination of teachings must be based on sound reasoning or technical evidence, and must be supported by a clear and particular suggestion in the prior art, not merely by a post-hoc assessment that such a modification or combination would have been supported by common sense or common knowledge. *In re Lee*, 61 USPQ2d 1430 (Fed. Cir. 2002); *Winner International Royalty Corp.*, 53 USPQ2d 1580; *Ruiz*, 57 USPQ2d 1161. The mere fact that prior art could have been modified or combined to produce the claimed invention, even on rational or logical grounds, is not a proper basis for an obviousness rejection unless the prior art would have suggested the desirability of carrying out such a modification or combination. *Ex parte Metcalf*, 67 USPQ2d 1633 (Fed. Cir. 2003) (non-precedential); *In re Gordon*, 221 USPQ 1125, 1127 (Fed. Cir. 1984); *In re Laskowski*, 10 USPQ2d 1397 (Fed. Cir. 1989). Furthermore, the prior art must also have given the ordinarily skilled artisan a reasonable expectation of achieving success by carrying out such a modification. *In re Dow Chemical Co.*, 5 USPQ2d at 1531; *In re Vaeck*, 20 USPQ2d at 1442-43. These principles apply to modifications based on combining teachings from plural references as well as modifications of the teachings of a particular reference. *See In re Rouffet*, 47 USPQ2d at 1456-58.

The claim being examined cannot be used as a "blueprint" to guide the selection and rearrangement of components from different prior art references to reconstruct the inventive combination; instead the prior art itself must have provided the suggestions toward the combination being claimed. *Interconnect Planning Corp. v. Feil*, 227 USPQ 543 (Fed. Cir. 1985). Even if individual components of the claimed combination were separately known in the prior art, the combination would not have been obvious if there was no suggestion to make the combination in the prior art. *Arkie Lures, Inc.*, 43 USPQ2d 1294.

The level of ordinary skill in the art is to be determined in view of the educational level of the inventor and the active workers in the field, the type of problems encountered in the art, the prior art solutions to those problems, the rapidity of innovation in the field, and the sophistication of the techniques involved, all at the time when the invention was made. *Custom Accessories, Inc. v. Jeffrey-Allan Industries, Inc.*, 1 USPQ2d 1196 (Fed. Cir. 1986). Failure to make findings regarding the level of ordinary skill may be evidence that the proper *Graham* analysis was not applied. *Id.* The person of ordinary skill thinks along the lines of the conventional wisdom at the time, and is not one who undertakes to innovate. *See Standard Oil Co. v. American Cyanamid Co.*, 227 USPQ 293, 298 (Fed. Cir. 1985).

2) Scope and Content of the Prior Art - Ishibashi et al.

U. S. Patent 5,617,446 (Ishibashi et al.) discloses a light-emitting device having a structure that is generally pertinent to the device of the present invention. The light-emitting device according to Ishibashi et al. includes an n-type semiconductor substrate (1), an n-side electrode (15) on the bottom or back surface of the substrate (1), several n-type semiconductor layers (2, 3, 4, 5) stacked on top of the substrate (1), and several p-type semiconductor layers (7, 8, 9, 10, 11) above the n-type layers, with an active light-emitting layer or region (6) between the n-type layers and the p-type layers. The light-emitting device further includes an upper electrode structure for conducting, spreading and injecting a current into the p-type semiconductor material of the device, to be supplied to the active region (6). In this regard, see col. 3, lines 12 to 35; as well as Figs. 1 and 2 of the reference.

The p-side or upper electrode structure of the device according to Ishibashi et al. is significantly different from the present inventive upper electrode structure. The upper electrode structure according to Ishibashi et al. includes a grid-shaped p-side electrode (13) of Au or Pd/Pt/Au or the like formed on top of a p-type ZnTe semiconductor contact layer (12), and an Au thin film (14) formed over the entire surface so as to cover the p-side grid electrode

(13) and the p-type semiconductor contact layer (12). In this regard see col. 3, lines 28 to 34 and col. 4, lines 15 to 18.

The grid-shaped p-side electrode (13) carries and distributes the current, while the Au film (14) functions as a transparent electrode to spread the current over the surface of the device, and the transparent p-type semiconductor contact layer (12) further functions as a transparent electrode to spread the current and provide a good ohmic contact with the p-side grid electrode (13) and the Au film (14) (see col. 4, lines 25 to 28 and 46 to 61; col. 5, lines 11 to 23; col. 6, lines 49 to 67; col. 7, lines 44 to 57; etc.).

Ishibashi et al. do not disclose the thickness of the Au film (14). Ishibashi et al. do not disclose an n-type transparent semiconductor film formed on top of the Au thin film (14). To the contrary, the Au thin film (14) forms the uppermost surface of the device, and is provided on top of a p-type semiconductor layer (12). Ishibashi et al. do not disclose any sort of n-type semiconductor layer being provided anywhere above the active region (6). Ishibashi et al. do not disclose an n-type semiconductor layer made of In_2O_3 - 10 wt.% ZnO. The n-type and p-type semiconductor layers may be made of various Zn-based semiconductor materials, such as ZnTe, ZnSe, ZnSe/ZnTe, ZnSSe, ZnMgSSe, etc. Ishibashi et al. do not provide any disclosure, suggestion or motivation for arranging an additional layer such as an n-type transparent semiconductor film on top of the Au thin film, but to the contrary repeatedly disclose that the combination of the uppermost Au thin film (14), the grid electrode (13), and the underlying p-type semiconductor contact layer (12) provide excellent current spreading into the underlying p-type semiconductor material (see e.g. col. 4, line 15 to col. 5, line 23 and col. 6, lines 49 to 67).

3) Scope and Content of the Prior Art - The Secondary References

Japanese Patent Laying-Open Document 06-318406 (Kazuyoshi et al.) discloses a technique of manufacturing a film of In_2O_3 - 10 wt. % ZnO by means of sputtering to form a transparent conductor film on an electrically insulating transparent substrate (e.g. a glass substrate). The upper electrode according to Kazuyoshi et al. is formed only of a transparent conductor film of this In_2O_3 - 10 wt. % ZnO material. Kazuyoshi et al. do not disclose a multi-layered upper electrode, do not disclose or suggest providing an In_2O_3 - 10 wt. % ZnO film on top of an Au film, and do not disclose or suggest providing such an arrangement on top of a p-type semiconductor layer. Kazuyoshi et al. do not disclose or suggest that the layer of In_2O_3 - 10 wt. % ZnO is even able to be formed on top of an Au film and/or a p-type semiconductor material, and Kazuyoshi et al. do not disclose or suggest that the In_2O_3 - ZnO is more resistant to humidity and the like than an Au thin film.

U. S. Patent 6,255,003 (Woodard et al.) discloses thermally reflective and/or electrically conductive films provided on transparent sheets such as glazing sheets, in the manner of a transparent solid substrate and one or more stacked transparent gold-clad silver layers supported by the substrate (Abstract). Woodard et al. mention that the electrically conductive metal layers can be used in electronic devices such as photoconductive devices and electroluminescent structures (col. 1, lines 30 to 38). In order to avoid the oxidation or corrosion of a silver layer as a heat-reflective layer on a glazing sheet, Woodard et al. disclose to provide a gold **cladding** layer on one or both sides of the **silver** layer on the transparent solid substrate such as a sheet of plastic or glass (col. 1, lines 50 to 60; col. 2, lines 26 to 62). The gold-clad silver layers are produced by sputter-depositing (col. 2, lines 63 to 64).

Woodard et al. further disclose that the gold layer used in the context of gold cladding for an underlying silver layer can have a thickness ranging from 0.3 Å to about 50 Å, and particularly from about 0.6 to about 30 Å (col. 5, lines 8 to 28). These thicknesses of the gold layer are

pertinent in the context of depositing gold as a cladding onto an underlying silver layer (see col. 5, lines 38 to 63). Woodard et al. do not disclose or suggest providing a gold layer on and in contact with an underlying p-type semiconductor layer, and under an n-type transparent semiconductor film. Woodard et al. do not disclose or suggest anything about a pertinent thickness range of a gold film positioned in contact with a p-type semiconductor layer, and in combination with an n-type transparent semiconductor film to form an upper electrode of a light-emitting device. Woodard et al. disclose only gold layer thicknesses that are pertinent for a gold cladding layer on an underlying thicker silver layer.

4) Differences Between the Prior Art and the Claims

It is acknowledged that Ishibashi et al. disclose a light-emitting device with a general device structure similar to the inventive device according to present claim 16, namely including a substrate with an n-side lower electrode on the bottom or back surface thereof, a light-emitting layer provided on the substrate, a p-type semiconductor layer provided on the light-emitting layer, and an upper electrode structure provided on the p-type semiconductor layer. The structure, composition, and other properties of the upper electrode arrangement are entirely different in comparison to the present invention.

As admitted by the Examiner, Ishibashi et al. do not disclose that the Au thin film (14) of the upper electrode arrangement should have a thickness of 1 to 3 nm, as required by present claim 16. In this regard, the Examiner has referred to the disclosure of Woodard et al. Woodard et al. disclose that a gold film may have a thickness of 0.3 Å to about 50 Å in the context of providing such a gold film as a cladding layer on a thicker silver layer, to provide a gold-cladded silver coating as a thermally reflective or electrically conductive film on a transparent substrate. From the teachings of Woodard et al., a person of ordinary skill in the art would have learned and expected that such a thin gold layer with a thickness of 0.3 to 50 Å

is pertinent only in the context of providing the **gold cladding** on an underlying **silver** layer (see col. 5, lines 8 to 63 of Woodard et al.).

Neither Ishibashi et al. nor Woodard et al. teach or suggest what thickness an Au layer should have in the context of providing an Au layer in contact with a p-type semiconductor layer, and underlying an n-type transparent semiconductor film, to form an upper electrode of a light-emitting device as presently claimed. Woodard et al.'s teachings demonstrate only that it is technically possible to form such a thin Au layer, and that it is desirable to use such a layer thickness for a gold cladding layer arranged in contact with an underlying silver layer. A person or ordinary skill in the art considering Ishibashi et al. and Woodard et al. together would thus not have found the teachings of Woodard et al. pertinent to any issues or problems to be solved in the upper electrode arrangement according to Ishibashi et al. Namely, the Ishibashi et al. arrangement does not include a silver layer that would be in need of a gold cladding film according to Woodard et al. Also, the Au layer (14) in the Ishibashi et al. structure is not a cladding layer on an underlying silver layer, but rather is provided directly on a p-type semiconductor layer (12). Therefore, a person of ordinary skill in the art would have found no motivation, and would have had no reasonable expectation of success or of achieving improvements, benefits, or advantages, by making the Au layer (14) of the Ishibashi et al. arrangement to have a thickness as proposed by Woodard et al. in a very different context. The teachings of Woodard et al. cannot be taken out of the context in which they pertain.

Furthermore, the prior art of record provides other teachings regarding the thickness of an Au layer in the appropriate context, namely the context of using such an Au layer as a transparent electrode layer in the upper electrode of a light-emitting device. For example, as described in the background prior art discussion of the present specification, conventional Au layers of upper electrodes of light-emitting devices typically have a thickness of about 20 nm (see e.g. the present specification at page 3, lines 7 to 10; page 11, lines 1 to 7; and page 15, lines 3

to 6). Such prior art teachings pertaining to the context of the present invention cannot be ignored in favor of other teachings of Woodard et al. that are less-related to the present inventive context.

A second important difference between the references and present claim 16 is that the references neither disclose nor would have suggested that the upper electrode arrangement should include an n-type transparent semiconductor film formed on the Au thin film. Contrary to such an arrangement according to present claim 16, Ishibashi et al. disclose the Au layer (14) as the uppermost layer of the electrode structure. There is no additional layer whatsoever (neither an n-type semiconductor film nor a p-type semiconductor film nor any other type of film) formed on the Au thin film (14). There is also no suggestion or motivation toward providing any additional layer on top of the Au film (14). To the contrary, Ishibashi et al. disclose that the Au film (14) together with the grid-shaped metal p-side electrode (13) and the p-type semiconductor contact layer (12) provides excellent current spreading, optical transmissivity, and the like, (see e.g. col. 4, lines 15 to 51; col. 5, lines 10 to 23; col. 6, lines 49 to 67; and col. 7, lines 44 to 57).

In this regard, the Examiner has referred to Kazuyoshi et al. Kazuyoshi et al. disclose an n-type transparent semiconductor film of In_2O_3 - ZnO formed on an electrically insulating transparent glass substrate. Kazuyoshi et al. do not disclose nor suggest providing such an n-type transparent semiconductor film on top of and in combination with an Au film. Kazuyoshi et al. do not even disclose or suggest whether it would be possible to form such a transparent semiconductor film on a gold metal film rather than on a glass substrate. Thus, a person of ordinary skill in the art would have had no reasonable expectation of success, and no expectation of achieving any improvements or benefits by trying to provide the disclosed n-type transparent semiconductor film on top of an Au metal film. Particularly, Kazuyoshi et al. expressly disclose that the n-type semiconductor layer is to be formed on an electrically

insulating transparent base material, which, of course, excludes an electrically conducting Au layer (see paragraph 0001 of Kazuyoshi et al. translation).

Thus, a combined consideration of Ishibashi et al. and Kazuyoshi et al. would have provided no suggestion or motivation toward arranging the n-type transparent semiconductor film disclosed by Kazuyoshi et al. on top of the Au film of Ishibashi et al. Particularly, the Au film of Ishibashi et al. is not an electrically insulating substrate such as a glass substrate which is required by Kazuyoshi et al. as the substrate to carry the n-type transparent semiconductor film of In_2O_3 - ZnO . Secondly, there would have been no suggestion to provide a combination of an Au film plus an n-type transparent semiconductor film to form a multi-layered upper electrode, because each one of the two references, Kazuyoshi et al. and Ishibashi et al., provides merely the single-layered transparent conductor of either an In_2O_3 - ZnO layer or an Au layer. Each one of these layers operates by itself to achieve a good electrical conduction as explained in the two references. Thus, there would have been no motivation to provide both of these layers in combination. Particularly, there would have been no motivation or suggestion to provide the In_2O_3 - ZnO film on top of the Au film. Namely, even though there is no motivation or suggestion in either regard, a person of ordinary skill in the art could have just as much arranged the In_2O_3 - ZnO film underneath the Au film in the Ishibashi et al. electrode arrangement, rather than on top of the Au film. Neither of these two arrangements would have been motivated by the prior art, and it is merely by hindsight reconstruction that the Examiner is selecting the combined arrangement that corresponds to the present invention.

The Examiner has suggested that it would have been motivated and obvious to arrange the n-type transparent semiconductor In_2O_3 - ZnO layer of Kazuyoshi et al. over the Au film of Ishibashi et al. "*in order to seal the air and humidity from the light-emitting device*" because Kazuyoshi et al. teach that this compound is resistant to heat and high humidity. Such an alleged motivation ignores the actual facts and context of the electrode arrangement disclosed by Ishibashi et al., which includes an upper layer of Au (14). A person of ordinary skill in

the art would have known that an Au film itself is highly resistant to all manner of oxidation, corrosion, environmental influences and chemical reactivity. Thus, a person of ordinary skill in the art, based on reading Ishibashi et al., would have recognized that there is no need to "protect" or "seal" the Au film from air and high humidity or the like, because the Au film itself is already highly resistant to such influences.

The motivations proposed by the Examiner appear to arise solely from a **hindsight** understanding of the invention used as a "blueprint" to "pick and choose" separate features from separate prior art references, in the manner of a hindsight reconstruction of the invention, without technically sound motivations toward such modifications provided by the prior art itself.

Present claim 16 further requires that the n-type transparent semiconductor film provided and formed on the Au thin film to prepare a multi-layered upper electrode arrangement, is made of In_2O_3 - 10 wt. % ZnO. While Kazuyoshi et al. disclose such a material can be used to form a transparent semiconductive layer, there would have been no suggestion that such a material can be used in the presently claimed context, namely being formed on top of a conductive metal Au thin film. To the contrary, Kazuyoshi et al. provide a layer of such a material on an electrically insulating transparent substrate, and particularly a glass substrate. There would have been no suggestion and no reasonable expectation of success that such a material could be used to form a layer on a conductive metal Au thin film in the arrangement as presently claimed. Ishibashi et al. provide no suggestions in this regard whatsoever.

In view of the above, even if the teachings of all three references are considered in combination, there still would have been no suggestion toward a multi-layered upper electrode arrangement including an Au thin film positioned in contact with an underlying p-type semiconductor layer, and an n-type transparent semiconductor film formed on the Au thin film, wherein the Au thin film has a thickness of 1 nm to 3 nm and the n-type transparent

semiconductor film is made of In_2O_3 - 10 wt.% ZnO in the context of the presently claimed structural arrangement. The separate individual teachings of the separate individual prior art references would not have provided a motivation toward the combination as presently claimed. The Examiner has used the present claims as a blueprint to carry out an improper hindsight reconstruction of the inventive combination from individual features of different prior art references.

5) Level of Ordinary Skill in the Art

A person of ordinary skill in the art would have been aware of the disclosures of Ishibashi et al. and of the secondary references as discussed above, and would have generally acted in accordance therewith. The record of this prosecution history does not include information regarding the education and experience level of a person of ordinary skill in the art, and does not indicate what other general knowledge and information beyond that given in the applied references is within the level of ordinary skill. The analysis must thus be based on the disclosures, teachings, suggestions, and motivations of the applied prior art references, which define the level of ordinary skill, as discussed above.

6) Secondary Considerations of Non-Obviousness

There are no relevant secondary considerations of non-obviousness of record in this application.

7) Examiner's Errors in Obviousness Rejection

As evident in the above discussion, the Examiner's errors in the obviousness rejection of claim 16 are two-fold.

First, the Examiner has taken the teachings of the references out of the context in which the prior art features were disclosed, and instead the Examiner has used these features in a very different context or arrangement according to the invention. For example, Woodard et al. disclose an appropriate thickness range for a gold film used as a cladding layer for cladding a silver layer. Neither Woodard et al. nor the other two references would have suggested what is an appropriate thickness range of an Au film provided in contact with an underlying p-type semiconductor layer, and in combination with an n-type transparent semiconductor film so as to form thereof a multi-layered upper electrode as presently claimed. Similarly, while Kazuyoshi et al. disclose forming an In_2O_3 - ZnO film on an electrically insulating transparent substrate such as a glass substrate, neither Kazuyoshi et al. nor the other two references would have suggested or enabled forming such an In_2O_3 - ZnO film on a conductive metal Au thin film as presently claimed.

Secondly, the Examiner has committed the error of using hindsight reconstruction of the presently claimed invention, based on alleged motivations that are not reasonably or rationally supported by teachings of the prior art. For example, the alleged motivation of providing the In_2O_3 - ZnO layer on top of the Au film, for sealing the Au layer and providing protection against moisture and the like, makes no sense in the context of the structure according to Ishibashi et al., in which the top layer of gold is already by itself highly resistant to moisture, corrosion, oxidation, etc. In other words, there would have been no motivation to protect the gold film from moisture and the like, because a gold film does not need such protection.

8) Conclusion of Non-Obviousness of Claims 16, 19, 20, 22, 23

In consideration of the above differences between the invention and the overall disclosures of the prior art, the overall inventive combination of features of present independent claim 16, viewed as a whole, would not have been obvious to a person of ordinary skill in the art at the time the invention was made, in consideration of Ishibashi et al. and the secondary references.

In view of the above discussed errors in the Final Rejection, it is submitted that the Examiner has not made out a prima facie case of obviousness that is properly supported by the prior art. Moreover, in view of the above discussion of the disclosures of the prior art, it is submitted that the applicant has overcome a prima facie case of obviousness, if such a prima facie case has been established.

E) FIFTH ISSUE - NON-OBVIOUSNESS OF CLAIM 21 OVER ISHIBASHI ET AL. COMBINED WITH SECONDARY REFERENCES

1) Legal Standards for Obviousness Determination

The legal standards for an obviousness determination have been discussed above in Section VIII-D)1), and apply here as well.

2) Scope and Content of the Prior Art - Ishibashi et al.

The pertinent disclosures of Ishibashi et al. have been discussed above in Section VIII-D)2).

3) Scope and Content of the Prior Art - The Secondary References

The pertinent disclosures of Kazuyoshi et al. and Woodard et al. have been discussed above in Section VIII-D)3).

U. S. Patent 4,495,514 (Lawrence et al.) discloses a light-emitting device with a transparent electrode that includes a thin metal-based layer formed on a p-type semiconductor layer of the device, and a transparent metallic oxide electrode layer formed on the metal-based layer. The metal-based layer may be made of chromium, a gold-zinc alloy, or oxides thereof, having a thickness form 15 to 200 Å (col. 5, lines 1 to 4, line 27, line 64; col. 8, lines 52 to 54). The

transparent metallic oxide layer may consist of cadmium tin oxide, indium tin oxide, indium oxide, or the like (col. 8, lines 55 to 57). Additionally, a gold electrode can be provided in peripheral regions that do not overlie the pn-junction area, for example in the form of an opaque grid electrode (see col. 1, lines 30 to 39 and col. 6, lines 53 to 57). The semiconductor layers are layers of GaAs and/or GaAsP, as well as a transparent Si_3N_4 cover layer (col. 3, lines 7 to 26). Lawrence et al. do not disclose anything about the relative flatness or unevenness of the metal-based layer in comparison to the metallic oxide transparent electrode layer. Lawrence et al. also do not disclose that the transparent metallic oxide electrode layer itself has a multi-layered structure, and especially not that plural layers thereof should have different flatness or unevenness.

4) Differences Between the Prior Art and the Claims

Present dependent claim 21 recites that the n-type transparent semiconductor film of In_2O_3 - ZnO **itself** has a multi-layer structure including an upper In_2O_3 - ZnO layer and a lower In_2O_3 - ZnO layer. It is important to understand that the transparent semiconductor film itself includes this upper semiconductor layer and this lower semiconductor layer, in addition to and distinct from the underlying Au thin film. Furthermore, the lower layer of the transparent semiconductor film has a flattened surface, while the upper layer of the transparent semiconductor film has an uneven surface. As explained in the present specification (see page 12, lines 1 to 9), such a two-layered film of In_2O_3 - ZnO can be formed by changing the film-forming conditions such as the film-forming pressure, to result in different surface characteristics of the two successive layers of the In_2O_3 - ZnO material. This in turn improves the optical emission because the internal reflection of the generated light is reduced.

The Examiner asserts that "*Lawrence et al. disclose an electrode having a thin gold layer, which is a flattened layer, and an uneven upper transparent layer*". This inaccurately

characterizes the disclosure of Lawrence et al., and misunderstands the present invention of claim 21.

Present claim 21 requires that the n-type transparent semiconductor film itself has a multi-layer structure including a semiconductor upper layer and a semiconductor lower layer. Contrary thereto, Lawrence et al. does not disclose or suggest a transparent semiconductor film that itself has a multi-layer semiconductor structure. Instead, Lawrence et al. disclose only a single deposited layer of a metallic oxide transparent electrode. Ishibashi et al. and Kazuyoshi et al. also fail to disclose or suggest an n-type transparent semiconductor film that itself has a multi-layer structure including a semiconductor upper layer and a semiconductor lower layer.

Furthermore, the references especially do not disclose an n-type transparent semiconductor film with a multi-layer structure including a semiconductor lower layer having a flattened surface and a semiconductor upper layer having an uneven surface. The Examiner's assertion that "*Lawrence et al. disclose an electrode having a thin gold layer, which is a flattened layer, and an uneven upper transparent layer*" is inaccurate and not relevant to the present invention. According to present claim 21, it is not the gold film that has a flattened surface, but rather the semiconductor lower layer of the multi-layer n-type transparent semiconductor film that has a flattened surface. Secondly, Lawrence et al. do not disclose an electrode having a thin gold layer, but rather only an electrode having a thin chromium layer or a thin gold-zinc alloy layer. Also, the flatness or unevenness of this thin chromium or gold-zinc layer is not disclosed by Lawrence et al. and is not relevant to the present claim 21. Thirdly, Lawrence et al. do not disclose the relative unevenness of the metallic oxide transparent electrode layer (contrary to the Examiner's assertion), and even so, such a disclosure would not be relevant to the relative flatness and unevenness of two disparate semiconductor layers of a multi-layer transparent semiconductor film.

Thus, even considering the teachings of Lawrence et al. together with Ishibashi et al., Kazuyoshi et al., and Woodard et al. (as discussed above), a person of ordinary skill in the art would have found no teachings and no suggestions toward providing a multi-layer film of n-type In_2O_3 - ZnO transparent semiconductor material, whereby the upper In_2O_3 - ZnO layer has an uneven surface while the lower In_2O_3 - ZnO layer has a flattened surface, and this multi-layer semiconductor film is provided on top of a gold film which in turn is provided on top of and in contact with a p-type semiconductor layer, according to present claim 21. The especially pertinent differences between claim 21 and the prior art are that the prior art does not disclose and would not have suggested an n-type transparent semiconductor film which itself has a multi-layer structure including an upper layer of In_2O_3 - ZnO with an uneven surface, on top of a lower layer of In_2O_3 - ZnO with a flattened surface.

5) Level of Ordinary Skill in the Art

A person of ordinary skill in the art would have been aware of the disclosures of Ishibashi et al. and of the secondary references as discussed above, and would have generally acted in accordance therewith. The record of this prosecution history does not include information regarding the education and experience level of a person of ordinary skill in the art, and does not indicate what other general knowledge and information beyond that given in the applied references is within the level of ordinary skill. The analysis must thus be based on the disclosures, teachings, suggestions, and motivations of the applied prior art references, which define the level of ordinary skill, as discussed above.

6) Secondary Considerations of Non-Obviousness

There are no relevant secondary considerations of non-obviousness of record in this application.

7) Examiner's Errors in Obviousness Rejection

The Examiner's errors in the rejection of claim 21 involve an apparent misunderstanding of the features recited in claim 21, and a mischaracterization of the teachings of Lawrence et al. Particularly, present claim 21 requires that the In_2O_3 - ZnO film itself has a multi-layered structure including an upper layer of In_2O_3 - ZnO and a lower layer of In_2O_3 - ZnO. The Examiner has apparently misunderstood this, because the Examiner compares the claimed structure to the arrangement of Lawrence et al. including a thin metal-based layer and an upper transparent metallic oxide layer. That has nothing to do with, and would not have suggested providing an n-type transparent semiconductor film, which itself includes different upper and lower layers, on top of an Au film. The Examiner has mis-characterized the teachings of Lawrence et al., because the reference does not disclose an electrode having a thin gold layer, but rather a chromium or gold-zinc alloy layer. The Examiner has also mis-characterized the disclosure of Lawrence et al., because the reference does not disclose the relative flatness or unevenness of two layers of the electrode structure, and especially of two different layers of the upper transparent metallic oxide material.

8) Conclusion of Non-Obviousness of Claim 21

In consideration of the above differences between the invention and the overall disclosures of the prior art, the overall inventive combination of features of present dependent claim 21 together with independent claim 16, viewed as a whole, would not have been obvious to a

person of ordinary skill in the art at the time the invention was made, in consideration of Ishibashi et al. and the secondary references.

In view of the above discussed errors in the Final Rejection, it is submitted that the Examiner has not made out a prima facie case of obviousness that is properly supported by the prior art. Moreover, in view of the above discussion of the disclosures of the prior art, it is submitted that the applicant has overcome a prima facie case of obviousness, if such a prima facie case has been established.

F) SIXTH ISSUE - NON-OBVIOUSNESS OF CLAIMS 24 TO 28 OVER ISHIBASHI ET AL. COMBINED WITH SECONDARY REFERENCES

1) Legal Standards for Obviousness Determination

The legal standards for an obviousness determination have been discussed above in Section VIII-D)1), and apply here as well.

2) Scope and Content of the Prior Art - Ishibashi et al.

The pertinent disclosures of Ishibashi et al. have been discussed above in Section VIII-D)2).

3) Scope and Content of the Prior Art - The Secondary References

The pertinent disclosures of Kazuyoshi et al. and Woodard et al. have been discussed above in section VIII-D)3). Additionally, Woodard et al. disclose that the gold film with a thickness of 0.3 Å, provided as a cladding film on a silver layer, is not a continuous layer of gold (col. 5, lines 20 to 25). Woodard et al. also disclose that a mono-layer of gold has a thickness of 3 Å, which is thus apparently a continuous mono-layer of gold (col. 5, lines 22 and 50 to 52).

Woodard et al. do not disclose that a gold film having a thickness of 1 nm to 3 nm formed on an underlying p-type semiconductor layer would be discontinuous.

Okazaki discloses a light-emitting device comprising a sapphire substrate (1), an n-type nitride-based semiconductor layer (3) and a p-type nitride-based semiconductor layer (4) arranged with a light-emitting structure (S) therebetween on the substrate (1), and both a p-side electrode structure (7, 8, 9, 10) and an n-side electrode structure (5, 6) arranged on the same side, e.g. the top, of the semiconductor layers on the substrate. The p-side electrode structure includes plural metal layers (7, 8, 9) stacked on the p-type semiconductor layer (4), and a transparent electrode of ITO or the like stacked on the plural metal layers. Some of the metal layers may comprise Au. The first and second metal layers (7, 8) may be made so thin that they are discontinuous to form islands, which are then covered by the third metal layer. See col. 4, line 50 to col. 5, line 33; col. 7, lines 10 to 28; and col. 8, lines 38 to 58.

None of these secondary references disclose anything about selecting an oxygen content of an n-type transparent semiconductor film so as to minimize an oxygen-content-dependent variable electrical resistance of the semiconductor film.

4) Differences Between the Prior Art and the Claims

Claim 24 recites that the Au thin film is discontinuous so as to cover first areas of the underlying p-type semiconductor layer while leaving second areas of the p-type semiconductor layer uncovered, and the n-type transparent semiconductor film covers both the discontinuous portions of the Au film and the areas of the p-type semiconductor layer that are not covered by the discontinuous portions of the Au film. The references would not have suggested such an arrangement.

The Examiner asserts that "*Ishibashi et al., modified by Woodard et al. in claim 16 above, would disclose a discontinuous thin Au film*". That apparently refers to the disclosure of Woodard et al. relating to discontinuous gold films, but is taken out of context and does not apply to the present invention. As pointed out above, Woodard et al. disclose only that an extremely thin layer of gold, with a thickness of 0.3 Å (i.e. 0.03 nm) forms a discontinuous layer. Furthermore, Woodard et al. disclose that a gold film with a thickness of at least 3 Å (i.e. 0.3 nm) forms a continuous mono-layer of gold (col. 5, lines 22 and 50 to 52). Woodard et al. do not disclose or suggest that a gold film with a thickness of 1 to 3 nm as presently claimed would have been discontinuous, because Woodard et al. disclose that a film with a thickness of 3 Å (= 0.3 nm) already is a continuous mono-layer film.

Furthermore, the teachings of Woodard et al. in this regard are not pertinent, because they only relate to the formation of a gold film as a cladding layer on an underlying silver layer. In the present invention, the gold film is arranged directly in contact on an underlying p-type semiconductor material. Due to different adhesion and wetting properties of gold with respect to silver versus gold with respect to p-type semiconductor materials, a gold layer having the same thickness might have a different continuous or discontinuous character when deposited on silver versus p-type semiconductor material. Woodard et al. would not have told the ordinarily skilled artisan anything about the continuity or discontinuity of a gold film when it is deposited on a p-type semiconductor layer.

Thus, even a combination of Ishibashi et al. and Woodard et al. would not have suggested the present discontinuous character of the gold film according to present claim 24, because neither of these two references suggest a discontinuous gold film with a thickness of 1 to 3 nm formed on an underlying p-type semiconductor material.

Okazaki discloses discontinuous layers of e.g. titanium and magnesium, but these two discontinuous layers are covered by a third continuous layer (see e.g. Fig. 4). Thus, even

further combining the teachings of Okazaki with the other references applied herein, there still would have been no suggestion that an n-type transparent semiconductor film should cover discontinuous portions of an Au film and areas of an underlying p-type semiconductor layer that are not covered by the discontinuous portions of the Au film. To the contrary, Okazaki provides a continuous covering layer of metal to ensure that there is no direct contact of the ITO transparent electrode (10) with the underlying p-type semiconductor (4). Thus, Okazaki teaches directly away from the arrangement recited in present claim 24.

Present claim 26 recites that the n-type transparent semiconductor film of the upper electrode contains the particular content of oxygen that minimizes an oxygen-content-dependent variable electrical resistance of this semiconductor film. None of the references disclose anything in this regard, namely the references do not disclose or suggest anything about selecting an oxygen content in an n-type transparent semiconductor film so as to minimize the electrical resistance of the transparent semiconductor film. The Examiner has also not addressed this feature of a particular oxygen content. To the contrary, the Examiner has erroneously stated that this claim 26 "*is written in process limitation, which carries no patentable weight in a claim drawn to a device*". The Examiner's assertion is erroneous, because actually claim 26 requires a particular device characteristic, namely a particular oxygen content of the semiconductor layer. The references are silent in this regard.

5) Level of Ordinary Skill in the Art

A person of ordinary skill in the art would have been aware of the disclosures of Ishibashi et al. and of the secondary references as discussed above, and would have generally acted in accordance therewith. The record of this prosecution history does not include information regarding the education and experience level of a person of ordinary skill in the art, and does not indicate what other general knowledge and information beyond that given in the applied references is within the level of ordinary skill. The analysis must thus be based on the

disclosures, teachings, suggestions, and motivations of the applied prior art references, which define the level of ordinary skill, as discussed above.

6) Secondary Considerations of Non-Obviousness

There are no relevant secondary considerations of non-obviousness of record in this application.

7) Examiner's Errors in Obviousness Rejection

The Examiner's errors in the obviousness rejection of claims 24 to 28 are as follows.

The Examiner has mis-characterized the disclosure of Woodard et al., because Woodard et al. do not disclose that an Au film with a thickness of 1 nm to 3 nm is discontinuous. To the contrary, Woodard et al. disclose that an Au film with a thickness of 0.03 nm is discontinuous, while a film having a thickness of at least 0.3 nm is a (continuous) mono-layer of gold.

Furthermore, the Examiner has taken the teachings of Woodard et al. out of context, because those teachings are only pertinent to forming a gold film as a cladding layer on a silver layer, which does not teach anything about forming a gold layer on an underlying p-type semiconductor layer.

The Examiner asserts that "*Okazaki discloses an ITO transparent semiconductor film cover a layer of thin metal layer made of Au and its alloy*". Actually, Okazaki discloses an ITO transparent semiconductor film covering a multi-layer structure of metal, of which some layers may comprise Au, but the discontinuous lower layers are covered with a continuous upper layer, before depositing the ITO layer thereon. Okazaki purposely avoids a direct covering contact of the ITO transparent semiconductor film onto the underlying p-type semiconductor

layer, by providing a continuous upper metal layer therebetween, and thus teaches directly away from the present requirements of claim 24.

Regarding claim 26, the Examiner erroneously asserts that this claim "*is written in process limitation, which carries no patentable weight in a claim drawn to a device*". Actually, claim 26 recites a concrete structural or physical limitation of the device, namely a particular oxygen content of the n-type transparent semiconductor film. This has nothing to do with a process limitation, and must be considered in the patentability determination of claim 26. On the other hand, claim 27 (depending from claim 26) recites a product-by-process limitation, which is not being separately argued for the purposes of this Appeal.

Regarding claim 28, the Examiner does not explain how the applied references allegedly disclose both the continuous Au film according to claim 28, as well as the discontinuous Au film according to claim 24.

8) Conclusion of Non-Obviousness of Claims 24 to 28

In consideration of the above differences between the invention and the overall disclosures of the prior art, the overall inventive combinations of features of present dependent claims 24 to 28 together with independent claim 16, respectively viewed as a whole, would not have been obvious to a person of ordinary skill in the art at the time the invention was made, in consideration of Ishibashi et al. and the secondary references.

In view of the above discussed errors in the Final Rejection, it is submitted that the Examiner has not made out a prima facie case of obviousness that is properly supported by the prior art. Moreover, in view of the above discussion of the disclosures of the prior art, it is submitted that the applicant has overcome a prima facie case of obviousness, if such a prima facie case has been established.

G) SEVENTH ISSUE - NON-OBVIOUSNESS OF CLAIM 29 OVER ISHIBASHI ET AL. COMBINED WITH SECONDARY REFERENCES

1) Legal Standards for Obviousness Determination

The legal standards for an obviousness determination have been discussed above in Section VIII-D)1), and apply here as well.

2) Scope and Content of the Prior Art - Ishibashi et al.

The pertinent disclosures of Ishibashi et al. have been discussed above in Section VIII-D)2).

3) Scope and Content of the Prior Art - The Secondary References

The pertinent disclosures of Kazuyoshi et al. and Woodward et al. have been discussed above in section VIII-D)3).

U. S. Patent 6,271,460 (Yamashita et al.) discloses a thermoelectric element including a p-type semiconductor material (1) and an n-type semiconductor material (3) forming a pn-junction therebetween to provide an electrical output current or voltage generated by the thermoelectric Seebeck effect when the junction is heated. Furthermore, a metal film of Ag, Al or silver solder is provided at the interface of the pn-junction between the two semiconductor materials, whereby the compositions of the semiconductor materials and this metal film material are selected so as not to form a substantial Schottky barrier between the metal and the semiconductor, while still providing a suitable pn-bond of the two semiconductors (col. 7, lines 3 to 38). Yamashita et al. do not disclose anything about avoiding the formation of a pn-junction of an interface of a transparent conductive electrode structure and an underlying semiconductor body of a light-emitting device.

4) Differences Between the Prior Art and the Claims

Present claim 29 recites that the thickness of the Au thin film of the upper electrode is sufficient to prevent the formation of a pn-junction between the underlying p-type semiconductor layer of the device and the overlying n-type transparent semiconductor film of the upper electrode. Contrary thereto, Yamashita et al. do not relate to a light-emitting device at all, but rather to a thermo-electric element that uses a heat input to generate an electrical output. Also, the film of Ag provided by Yamashita et al. aims to avoid or reduce the formation of a Schottky barrier between the bonding metal film and the semiconductors. This does not disclose or suggest avoiding the formation of a pn-junction between the upper electrode and the semiconductor body of a light-emitting device, but rather distinctly suggests reducing a Schottky barrier that arises between the metal and the semiconductors, by properly selecting the metal and the composition of the semiconductors.

As admitted by the Examiner, Ishibashi et al. do not disclose an n-type transparent semiconductor layer arranged on top of the Au thin film, so there would be no question or issue of establishing or preventing a pn-junction in the upper electrode arrangement according to Ishibashi et al. Kazuyoshi et al. provide an In_2O_3 - ZnO material, but only on an electrically insulating substrate such as a glass substrate. Therefore, the teachings of Kazuyoshi et al. regarding an In_2O_3 - ZnO material also would not have provided any suggestions or motivations regarding the formation or avoidance of a pn-junction. Even if Kazuyoshi et al. and Ishibashi et al. would have been considered together, there still would have been no suggestion relation to the formation or avoidance of a pn-junction, because neither one of these references relates to such a feature. Woodard et al. also provide no suggestions regarding the avoidance of a pn-junction, because Woodard et al. only provide the Au film as a cladding film on a conductive metal silver layer.

5) Level of Ordinary Skill in the Art

A person of ordinary skill in the art would have been aware of the disclosures of Ishibashi et al. and of the secondary references as discussed above, and would have generally acted in accordance therewith. The record of this prosecution history does not include information regarding the education and experience level of a person of ordinary skill in the art, and does not indicate what other general knowledge and information beyond that given in the applied references is within the level of ordinary skill. The analysis must thus be based on the disclosures, teachings, suggestions, and motivations of the applied prior art references, which define the level of ordinary skill, as discussed above.

6) Secondary Considerations of Non-Obviousness

There are no relevant secondary considerations of non-obviousness of record in this application.

7) Examiner's Errors in Obviousness Rejection

In the rejection of claim 29, the Examiner states that Ishibashi et al. "*do not disclose an n-type transparent semiconductor layer on the Au thin film forming a pn-junction*". This could tend to lead to a misunderstanding of present claim 29, which actually requires that the Au thin film avoids or prevents the formation of a pn-junction between the p-type semiconductor layer of the device and the n-type transparent semiconductor film of the upper electrode. The Examiner's discussion of Yamashita et al, and its alleged motivation to purposely form a Schottky barrier using a metal such as Ag at an interface between the p-type and n-type semiconductor layers, seems to mis-characterize the true disclosure of Yamashita et al. as discussed above. Even when all the references are considered together, there would have been

no indication whether the claimed thickness range of the gold film from 1 nm to 3 nm would have been suitable for preventing the formation of a pn-junction.

8) Conclusion of Non-Obviousness of Claim 29

In consideration of the above differences between the invention and the overall disclosures of the prior art, the overall inventive combination of features of present dependent claim 29 together with independent claim 16, viewed as a whole, would not have been obvious to a person of ordinary skill in the art at the time the invention was made, in consideration of Ishibashi et al. and the secondary references.

In view of the above discussed errors in the Final Rejection, it is submitted that the Examiner has not made out a prima facie case of obviousness that is properly supported by the prior art. Moreover, in view of the above discussion of the disclosures of the prior art, it is submitted that the applicant has overcome a prima facie case of obviousness, if such a prima facie case has been established.

IX. OTHER PROCEDURAL MATTERS

The following additional procedural matters should also be considered.

The Examiner has not yet acknowledged and approved the Drawing Correction filed on October 3, 2001 and the Supplemental Drawing Correction filed on October 26, 2001. The Examiner is respectfully requested to approve these Drawing Corrections, so that proper corrected Formal Drawings can then be filed.

The Examiner has not yet expressly acknowledged the receipt and entry of the Supplemental Amendment that was filed on October 3, 2001. Entry and acknowledgment thereof are respectfully requested.

A further Information Disclosure Statement was filed on May 5, 2003, together with the Notice of Appeal. We have not yet received an acknowledgment of that IDS. The Examiner is respectfully requested to consider the references, and to return an initialed, signed and dated acknowledgment copy of the corresponding IDS Form PTO-1449 of May 5, 2003, together with the next official communication.

Another new Information Disclosure Statement is being filed together with this Appeal Brief. The Examiner is respectfully requested to consider and acknowledge this new enclosed Information Disclosure Statement.

X. RELIEF REQUESTED

The Board is respectfully requested to:

A) Reverse the Final rejection of claim 24 under 35 U.S.C. §112, first paragraph;

B) Reverse the Final rejection of claim 24 (and apparently also claim 28) under 35 U.S.C. §112, second paragraph;

C) Reverse the Final rejection of claims 16, 19, 20, 22 and 23 under 35 U.S.C. §103, over Ishibashi et al. in view of Kazuyoshi et al. and Woodard et al.;

D) Reverse the Final rejection of claim 21 under 35 U.S.C. §103 over Ishibashi et al. in view of Kazuyoshi et al., Woodard et al., and Lawrence et al.;

E) Reverse the Final rejection of claims 24 to 28 under 35 U.S.C. §103 over Ishibashi et al. in view of Kazuyoshi et al., Woodard et al., and Okazaki;

F) Reverse the Final rejection of claim 29 under 35 U.S.C. §103 over Ishibashi et al in view of Kazuyoshi et al., Woodard et al., and Yamashita et al.;

G) Direct the Examiner to address the other procedural matters set forth in section IX above;

H) Enter a Final decision, allowing all pending claims 16 and 19 to 29; and

I) Direct such further action on this application as may be appropriate.

Respectfully submitted,

Takao NAKAMURA et al.
Applicant/Appellant

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Enclosures: postcard,
Term Extension Request,
Form PTO-2038,
2 copies of Appeal Brief,
3 copies of Appendix A,
Information Disclosure Statement,
Form PTO-1449,
1 reference,
Form PTO-2038

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_____ 9/8/03
Name: Walter F. Fasse - Date: September 8, 2003

Docket No.: 3905

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN THE MATTER OF THE APPLICATION FOR PATENT

OF: Takao NAKAMURA et al. | ART UNIT: 2814

SERIAL NO.: 09/519,408 | EX.: W. S. Louie

FILED: March 3, 2000 |

FOR: Semiconductor Light-Emitting Device, Method of Manufacturing Transparent Conductor Film and Method of Manufacturing Compound Semiconductor Light-Emitting Device

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September 8, 2003

APPENDIX A

CLAIMS ON APPEAL

3905/WFF:ar

Claims 1 to 15 (canceled).

16. (previously presented) A semiconductor light-emitting device comprising:

a substrate having a back surface provided with an n-type lower electrode;

a light-emitting layer provided on said substrate;

a p-type semiconductor layer provided on said light-emitting layer; and

an upper electrode provided on said p-type semiconductor layer;

wherein said upper electrode includes an Au thin film positioned in contact with said p-type semiconductor layer and an n-type transparent semiconductor film formed on said Au thin film; and

wherein said Au thin film has a thickness of 1 nm to 3 nm and said n-type transparent semiconductor film is made of In_2O_3 - 10 wt.% ZnO.

Claims **17** and **18** (cancelled).

19. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said transparent semiconductor film of In_2O_3 - 10 wt.% ZnO is formed by laser ablation and has characteristics as result from being formed by laser ablation.

20. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said thickness of said Au thin film is in a range of 2 nm to 3 nm and said n-type transparent semiconductor film is a layer of said In_2O_3 - 10 wt.% ZnO having a thickness of 180 nm to 200 nm.

21. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said n-type transparent semiconductor film has a multilayer structure including an upper layer and a lower layer, said lower layer having a flattened surface, and said upper layer having an uneven surface.

22. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said n-type transparent semiconductor film was deposited at room temperature and said device has characteristics as result from said n-type transparent semiconductor film having been deposited at room temperature.

23. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said p-type semiconductor layer is a semiconductor layer selected from the group consisting of a ZnSe-based semiconductor layer, a ZnTe-based semiconductor layer and a BeTe-based semiconductor layer.

24. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said Au thin film is discontinuous so as to cover first areas of said p-type semiconductor layer while leaving second areas of said p-type semiconductor layer uncovered, and said n-type transparent semiconductor film covers both said Au film and said second areas of said p-type semiconductor layer which are not covered by said Au film.

25. (previously presented) The semiconductor light-emitting device according to claim 24, wherein said Au thin film comprises separate discontinuous islands of said Au thin film respectively covering said first areas of said p-type semiconductor layer.

26. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said n-type transparent semiconductor film contains oxygen with such an oxygen content that minimizes an oxygen-content-dependent variable electrical resistance of said n-type transparent semiconductor film for a given thickness thereof.

27. (previously presented) The semiconductor light-emitting device according to claim 26, wherein said n-type transparent semiconductor film is formed by adjusting the partial pressure of oxygen in a laser ablation film forming method.

28. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said Au thin film and said n-type transparent semiconductor film are respective solid continuous films, and said upper electrode does not include a grid-shaped electrode.

29. (previously presented) The semiconductor light-emitting device according to claim 16, wherein said p-type semiconductor layer and said n-type transparent semiconductor film would form a p/n junction at an interface therebetween but for said Au thin film interposed therebetween, and wherein said thickness of said Au thin film is sufficient to prevent the formation of a p/n junction between said p-type semiconductor layer and said n-type transparent semiconductor film.